UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901
MAY 07 2019

Mr. Timothy S. Franquist
Director, Air Quality Division
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Dear Mr. Franquist: Tim

I am pleased to concur with your request to exclude data showing exceedances of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) on June 20, 2015, at six monitors in and near the Phoenix-Mesa, AZ nonattainment area under the Exceptional Events Rule (EER).

The submittals from Arizona Department of Environmental Quality (ADEQ)[1], dated September 27, 2016, May 17, 2018, and March 26, 2019, included documentation that the June 20, 2015 exceedances were caused by exceptional events due to wildfire emissions. We appreciate the technical thought and expertise brought to bear, and the collaborative approach used to develop these submittals. After thoroughly reviewing the information you provided, we agree that your submittals meet the demonstration criteria and the schedule and procedural requirements in the EER. The basis for our concurrence is set forth in the enclosed technical support document. My staff will enter concurrence flags for these data into the U.S. Environmental Protection Agency's (EPA's) Air Quality System database.

EPA's concurrence is a preliminary step in the regulatory process for actions that may rely on these data and does not constitute final Agency action. If EPA completes a notice-and-comment rulemaking for an action that is influenced by the exclusion of the O_3 data specified in this concurrence, EPA's concurrence letter and accompanying technical support document would be included in the record as part of the technical basis for the proposed action. If we receive comments, we must consider and respond to those comments before taking final regulatory action. When EPA issues that regulatory action, it is a final Agency action subject to judicial review.

[1] While submitted by ADEQ, the demonstration and addenda were developed through a joint effort by ADEQ, Maricopa Association of Governments (MAG), and Maricopa County Air Quality Department.

If you have any questions or wish to discuss this matter further, please contact me at (415) 972-3183, or Meredith Kurpius at (415) 947-4534.

Sincerely,

Elizabeth J. Adams
Director, Air Division

Enclosure

cc (via email): Brad Busby, ADEQ
Lindy Bauer, MAG
Matthew Poppen, MAG

ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON O_3 EXCEEDANCES MEASURED IN THE PHOENIX-MESA 2008 8-HOUR O_3 NONATTAINMENT AREA ON JUNE 20, 2015 AS EXCEPTIONAL EVENTS

On September 27, 2016, Arizona Department of Environmental Quality (ADEQ) submitted an exceptional event demonstration for exceedances of the 2008 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) that occurred at the Apache Junction, Blue Point, Falcon Field, Mesa, Pinnacle Peak, and Tonto National Monument monitoring sites on June 20, 2015.[1] ADEQ also submitted one addendum on May 17, 2018, and a second addendum on March 26, 2019, to supplement the demonstration. [2,3,4] The demonstration and addenda submitted by ADEQ stated that the exceedances measured on June 20, 2015, were caused by the Lake Fire in the San Bernardino National Forest in southeastern California.[5] Under the Exceptional Events Rule (EER), air agencies can request the exclusion of event-influenced data, and the Environmental Protection Agency (EPA) can agree to exclude these data from the data set used for certain regulatory decisions. The remainder of this document summarizes the EER requirements, the event, and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the EER in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the EER. The 2007 EER and 2016 revisions added 40 CFR 50.1(j)-(r); 50.14; and 51.930 to the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the EER criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR 50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);"

B. "A demonstration that the event affected air quality in such a way that there exists a

[1] "State of Arizona Exceptional Event Documentation for Wildfire-Caused Ozone Exceedances on June 20, 2015 in the Maricopa Nonattainment Area," (September 2016) ("demonstration").
[2] "Addendum to: State of Arizona Exceptional Event Documentation for Wildfire-Caused Exceedances on June 20, 2015 in the Maricopa Nonattainment Area – September 2016; Additional Evidence that Ozone and Ozone Precursor Emissions From the Lake Fire Reached and Affected Ozone Monitors Within the Maricopa Nonattainment Area" (May 2018) ("first addendum").
[3] "Addendum to: State of Arizona Exceptional Event Documentation for Wildfire-Caused Exceedances on June 20, 2015 in the Maricopa Nonattainment Area – September 2016; Expanded Conceptual Model Linking Ozone and Ozone Precursors From the Lake Fire with the Ozone Exceedances in the Maricopa Nonattainment Area," (March 2019) ("second addendum").
[4] While submitted by ADEQ, the demonstration and addenda were developed through a joint effort by ADEQ, Maricopa Association of Governments, and Maricopa County Air Quality Department.
[5] See demonstration, p. 1.

clear causal relationship between the specific event and the monitored exceedance or violation;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[6]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR 50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR 50.14(c)(3)(v), and

3. implementation of any applicable mitigation requirements as described in 40 CFR 51.930.

For data influenced by exceptional events to be used in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR 50.14 must be met. We include below a summary of the EER criteria, including those identified in 40 CFR 50.14(c)(3)(iv).

Regulatory Significance

The 2016 EER includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR 50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

[6] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

Narrative Conceptual Model

The 2016 EER directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and, under 40 CFR 50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[7] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/ O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (e.g., 5-10 ppb higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

[7] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016).

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.
    - *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
        - is in the 99th or higher percentile of the 5-year distribution of O_3 monitoring data, OR
        - is one of the four highest O_3 concentrations within 1 year (among those concentrations that have not already been excluded under the EER, if any).
    - In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
    - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The EER requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[8]

Natural Event or Event Caused by Human Activity That is Unlikely to Recur

According to the CAA and the EER, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 EER includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement

[8] A wildfire is defined in 40 CFR 50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On July 8, 2016, ADEQ submitted an Initial Notification of Potential Exceptional Event for exceedances of the 2008 8-hour O_3 NAAQS that occurred at the Apache Junction, Blue Point, Falcon Field, Mesa, Pinnacle Peak, and Tonto National Monument monitoring sites within Pinal, Maricopa, and Gila counties in Arizona on June 20, 2015. [9] ADEQ submitted an updated Initial Notification on March 27, 2018.[10] On September 27, 2016, ADEQ submitted the demonstration for these exceedances.[11] After conversations with the EPA, ADEQ submitted two addenda on May 17, 2018, and March 26, 2019, to supplement the demonstration.[12]

Regulatory Significance

The EPA determined that data exclusion of the exceedances may have regulatory significance for attainment by the Moderate area attainment date for the Phoenix-Mesa, AZ nonattainment area for the 2008 8-hour O_3 NAAQS (hereafter "nonattainment area"), and worked with ADEQ to identify the relevant exceedances and monitoring sites affected.[13] Table 1 summarizes the exceedances that ADEQ included in the demonstration.

Table 1: EPA 2008 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitor/Site Name	AQS ID	8-hour Avg. (ppm)
June 20, 2015	Apache Junction	04-021-3001	0.078
June 20, 2015	Blue Point	04-013-9702	0.077
June 20, 2015	Falcon Field	04-013-1010	0.080
June 20, 2015	Mesa	04-013-1003	0.079
June 20, 2015	Pinnacle Peak	04-013-2005	0.078
June 20, 2015	Tonto National Monument[14]	04-007-0010	0.079

Narrative Conceptual Model

The demonstration and addenda submitted by ADEQ provided a narrative conceptual model to describe how emissions from the Lake Fire in southeastern California caused O_3 exceedances at

[9] See email from Brad Busby, ADEQ, to Randall Chang, EPA Region 9, dated July 8, 2016.
[10] See letter from Timothy Franquist, ADEQ, to Elizabeth Adams, EPA Region 9, dated March 27, 2018.
[11] See letter from Timothy Franquist, ADEQ, to Deborah Jordan, EPA Region 9, dated September 27, 2016.
[12] See letter from Timothy Franquist, ADEQ, to Alexis Strauss, EPA Region 9, dated May 17, 2018, and letter from Timothy Franquist, ADEQ, to Mike Stoker, EPA Region 9, dated March 26, 2019.
[13] See letter from Gwen Yoshimura, EPA Region 9, to Timothy Franquist, ADEQ, dated May 8, 2018.
[14] The Tonto National Monument monitor is just outside the nonattainment area boundary. For purposes of this document, references to the nonattainment area also reference the area around and including the Tonto National Monument monitor.

the Apache Junction, Blue Point, Falcon Field, Mesa, Pinnacle Peak, and Tonto National Monument monitoring sites on June 20, 2015. The narrative conceptual model in the demonstration included characteristics of the nonattainment area and surrounding areas, such as descriptions of typical O_3 formation, the ambient O_3 monitoring network, meteorology, geography, topography, emissions, and seasonal O_3 variations.[15]

The demonstration also described event-related characteristics and included ADEQ's claims that the observed exceedances were caused by emissions from the Lake Fire in the San Bernardino National Forest in southeastern California and that these exceedances qualify as an exceptional event under the EER. The demonstration included a summary of the event, stating that the Lake Fire was a human-caused wildfire that began on June 17, 2015, and the wildfire emissions impacted the nonattainment area and surrounding area on June 20, 2015. In addition to the Lake Fire, the demonstration identified additional, smaller fires southwest of Yuma, Arizona as well as larger fires to the east and north of the nonattainment area. The demonstration stated that while fires southwest of Yuma may have contributed to O_3 and O_3 precursors transported to the nonattainment area, the emissions produced were minimal compared to those from the Lake Fire, and that emissions from the fires to the north and east were not transported to the nonattainment area and surrounding area. The demonstration included Lake Fire perimeter maps from June 17, 2015, through June 20, 2015; a map of the Lake Fire perimeter as of July 7, 2015; active wildfires on June 20, 2015, in Arizona, southeastern California and northern Mexico; and satellite imagery of smoke from the Lake Fire on June 19, 2015.[16]

The demonstration presented tables and graphs of daily 8-hour maximum O_3 concentrations between June 13 and June 27, 2015, for all O_3 monitoring sites in the nonattainment area, as well as a separate graph for the six exceeding monitors.[17] The demonstration also included a diurnal profile of O_3 for those six monitors on June 20, 2015.[18] The first addendum added diurnal profiles of O_3 from the exceeding monitors compared to the 5^{th}, 50^{th}, and 95^{th} percentile hourly O_3 concentrations for those monitors, grouped by weekdays and weekends to account for differences in anthropogenic emissions. Graphs with percentiles calculated using data from 2010 through 2015, both for the month of June alone, and from the months of May through August, were included.[19] These datasets showed hours above the 95^{th} percentile at all six monitors on June 20, 2015, with lower O_3 concentrations on the preceding day. The first addendum noted that since June 20, 2015, was a Saturday, when local emissions are lower than on weekdays and exceedances are rare and typically follow higher concentrations measured on the preceding Friday, the exceedances were indicative of transport of outside emissions.

The demonstration stated that O_3 and O_3 precursor emissions from the fire were transported west to east to the nonattainment area and that elevated O_3 was observed at the Yuma Supersite, Alamo Lake, and Grand Canyon National Park monitors on June 19, 2015. Additionally, the demonstration described elevated particulate matter with an aerodynamic diameter less than or

[15] See demonstration, p. 5-7.
[16] See demonstration, p. 8-15.
[17] Throughout this demonstration, the phrase "exceeding monitors" refers to the six monitoring sites that measured exceedances on June 20, 2015.
[18] See demonstration, p. 16-20.
[19] See first addendum, p. 3-9.

equal to a nominal 2.5 micrometers ($PM_{2.5}$) observed at Yuma Supersite and Alamo Lake on June 18 and 19, 2015, indicating smoke at these monitors.[20] The second addendum expanded the conceptual model by clarifying that fire emissions were transported to the nonattainment area via two separate pathways.[21] The "upper-air" pathway involved transport of emissions from the fire to the east and northeast at upper altitudes on June 18 and 19, 2015, resulting in elevated $PM_{2.5}$ and O_3 at the rural Alamo Lake and Grand Canyon National Park monitors, followed by mixing of the emissions to ground level in the nonattainment area on June 20, 2015. The "lower-air" pathway asserted that fire emissions were also transported from the fire southeast to Yuma and mixed down to ground level on June 18 and 19, 2015, then were transported northwest at ground level to the nonattainment area.

Based on the information described above, the demonstration with addenda submitted by ADEQ meets the narrative conceptual model criterion of the EER.

Table 2: Documentation of Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 20, 2015	Demonstration – p. 5-20 First addendum – p. 3-9 Second addendum – p. 2-12	Sufficient	Yes

Clear Causal Relationship

The demonstration and addenda included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR 50.14(c)(3)(iv)(C).[22] The demonstration compared the event-related O_3 concentrations with all concentrations from 2011 through 2015 measured in the months of April through October. The plots provided show that daily maximum 8-hour average O_3 concentrations on June 20, 2015, were at or above the 5-year 99th percentile value for all of the exceeding monitors except for Pinnacle Peak, which had a concentration of 0.078 parts per million (ppm), below the 99th percentile value of 0.080 ppm for the site. The Pinnacle Peak concentration was the third highest daily maximum 8-hour average O_3 concentration in 2015.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other, non-event related exceedances, or occur during a time of year that typically experiences no exceedances. The event-related exceedances identified in this demonstration occurred during the regular O_3 season, during times when other exceedances similar in magnitude were measured. Therefore, the event exceedances do not meet the Tier 1 Key Factor, and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

[20] See demonstration, p. 16.
[21] See second addendum, p. 2-12.
[22] See demonstration, p. 21-27.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfire to the monitoring site locations.[23] Q was calculated from emissions during June 17, 18, and 19, 2015, for the Lake Fire using perimeter growth and BlueSky Playground.[24] The demonstration evaluated Q as a sum over the three-day period, and also calculated Q separately for June 18 and 19, 2015, stating that it was primarily O_3 and O_3 precursor emissions from these two days that were transported to the nonattainment area and caused the exceedances on June 20, 2015. The EPA's wildfire O_3 guidance document describes using a single day of emissions to calculate Q/D. The demonstration calculated the distance D from the Lake fire to the Mesa monitor, which is somewhat centrally located within the nonattainment area. Using these values, Q/D for June 17-19, 2015, was determined to be 54 tons of NO_x and VOC over the three days per km; Q/D was determined to be 21.6 tons per km for June 18, 2015, and 32.1 tons per km for June 19, 2015. These values are all well below the Tier 2 Key Factor 1 screening value of 100 tons per day/km. Therefore, the event exceedances do not meet Tier 2 Key Factor 1.

For Tier 2 Key Factor 2, as described previously, the demonstration included evidence that the exceedances were at or above the 99th percentile of the previous five years of O_3 season data or were among the four highest concentrations measured at the site in 2015.[25] Five of the six monitors had daily maximum 8-hour average O_3 concentrations during the event at or above the 99th percentile for the 5-year period while one monitor (Pinnacle Peak) did not. However, the event O_3 concentration at Pinnacle Peak was the third highest O_3 concentration measured at the site in 2015. Therefore, the event exceedances meet Tier 2 Key Factor 2.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration with addenda included the required elements for a Tier 3 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence to support that (1) wildfire emissions were transported from the wildfire to the monitor; (2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedances.

Evidence of transport of wildfire emissions from the wildfire to the monitor

The demonstration presented a trajectory analysis using the HYbrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT),[26] along with satellite imagery of smoke and National Oceanic and Atmospheric Administration (NOAA) smoke contours for light, medium, and heavy smoke.[27] The demonstration included 36-hour HYSPLIT back trajectories from the six affected monitoring sites at 100- and 1500-meter altitudes initiated at the hour of highest O_3 concentration for each monitor on June 20, 2015, overlaid on satellite photos of smoke from the Lake Fire on June 19, 2015. HYSPLIT trajectories were calculated using the Eta Data Assimilation System (EDAS) 40-kilometer resolution model on pressure surfaces. NOAA smoke contour maps were also provided for June 17 through 20, 2015. The back trajectories in the demonstration generally pointed to transport from the southwest, including areas around Yuma and further west (e.g.,

[23] See demonstration, p. 28-30.
[24] U.S. Forest Service's BlueSky Playground, available at *https://tools.airfire.org/playground/*.
[25] See demonstration, p. 21-27, 30.
[26] HYSPLIT is available on the NOAA Air Resources Laboratory website at *https://www.ready.noaa.gov/HYSPLIT.php*.
[27] See demonstration, p. 31-42, Appendix C.

Mexicali in Mexico, and Imperial County and San Diego County in California), and passed well south of the Lake Fire. The trajectories did pass through areas where smoke was visible or was indicated by the HMS smoke contours on June 19, 2015; however, the analysis did not assess at what altitude the smoke was present, and thus did not show that the trajectories transported smoke to the nonattainment area. The visible smoke and HMS contours also provided evidence that smoke was present over the nonattainment area on June 19, 2015, but did not provide evidence that the smoke was at ground level, nor that smoke was present over the nonattainment area on June 20, 2015.

The second addendum provided additional analyses to clarify transport of wildfire emissions and mechanisms for mixing to ground level along "upper-air" and "lower-air" pathways identified and described in the expanded conceptual model. To show transport patterns for both pathways, the second addendum calculated HYSPLIT trajectories using a different input dataset, the North American Mesoscale (NAM) 12-kilometer resolution model on sigma surfaces. These HYSPLIT trajectories reflect higher model spatial resolution and improved treatment of terrain features using sigma surfaces. The second addendum also evaluated transport to the nonattainment area across a range of hours, rather than a single hour of highest O_3 concentration, to assess transport of precursors.

To show transport along the "upper-air" pathway, the second addendum provided HYSPLIT 36-hour forward trajectories from the Lake Fire at 2500 meters initiated every four hours from 12:00AM until 8:00PM on June 18 and June 19, 2015.[28] The trajectories on June 18, 2015, generally showed transport from the fire at upper altitudes to the northeast and east, with earlier trajectories passing near monitors well to the north of the nonattainment area (Grand Canyon National Park and Flagstaff Middle School), and shifting further south later in the day, towards monitors to the north and northwest of the nonattainment area (Alamo Lake and Prescott College). The final two trajectories initiated on June 18, 2015, passed over the nonattainment area at times corresponding to late night on June 19, 2015, and early morning on June 20, 2015. The trajectories initiated on June 19, 2015, generally showed transport south and west of the nonattainment area. The forward trajectories initiated on both June 18 and 19, 2015, at 2500 meters generally remained near this altitude and did not descend to the boundary layer. The second addendum also provided 36-hour back trajectories at 2500 meters from the nonattainment area (Pinnacle Peak monitor) initiated every four hours from 6:00PM on June 19, 2015, until 6:00PM on June 20, 2015.[29] The trajectories initiated in the morning hours on June 20, 2015, passed near the fire in the afternoon and evening on June 18, 2015. Together, these analyses showed that emissions from the fire on June 18, 2015 were transported to and were present over the nonattainment area in the morning hours of June 20, 2015. However, in all cases the trajectories generally stayed aloft, approximately 2500 meters above the ground.

To address whether the air masses transported from the fire to the nonattainment area along the "upper air" pathway reached the ground, the second addendum also provided evidence to support mixing of air over the nonattainment area to the surface on June 20, 2015.[30] The analysis looked

[28] See second addendum, p. 6-8. All time references in the HYSPLIT analysis are in Pacific Daylight Time/Mountain Standard Time, corresponding to the local time zone for both the Lake Fire and for the nonattainment area.
[29] See second addendum, p. 6, 9.
[30] See second addendum, p. 32-36.

at National Weather Service (NWS) soundings from 5:00AM and 6:00PM on the exceedance day. The soundings show that the boundary layer over the nonattainment area was capped at approximately 1500 meters in the early morning on June 20, 2015, but grew in depth to approximately 3000 meters by 6:00PM. This provides evidence for a mechanism for air aloft at 2500 meters over the boundary layer in the morning to be mixed down to ground level during the day on June 20, 2015. The second addendum also analyzed O_3 data from a higher elevation site within the nonattainment area (Humboldt Mountain) in comparison to the exceeding monitors at lower elevations to provide further evidence of a deep boundary layer and mixing of elevated O_3 and O_3 precursors transported from the Lake Fire.

To show transport along the "lower-air" pathway, the second addendum addressed transport in two segments. First, the second addendum provided HYSPLIT 24-hour back trajectories from the Yuma Supersite monitor at 100 meters initiated every four hours from 6:00PM on June 18, 2015 until 6:00PM on June 19, 2015.[31] The Yuma Supersite monitor measured an exceedance of the 2008 O_3 NAAQS on June 19, 2015. The trajectories from 6:00AM, 10:00AM, and 2:00PM on June 19, 2015 pass south of, but near, the Lake Fire in the late evening hours on June 18, 2015. The trajectories also descended from higher altitudes (approximately 1500 meters) near the fire to ground level in Yuma, providing evidence that emissions were transported from the fire to Yuma and affected air quality in Yuma on June 19, 2015. To show the second stage of transport from Yuma to the nonattainment area, the second addendum also provided 24-hour back trajectories at 100 meters from the nonattainment area (Pinnacle Peak monitor) initiated every four hours from 6:00PM on June 19, 2015 until 6:00PM on June 20, 2015.[32] The trajectories initiated in the late night hours on June 19, 2015 and morning hours on June 20, 2015 travel back at ground-level and pass over Yuma, consistent with the timing of trajectories from Yuma showing transport from the fire. Together, the "lower-air" back trajectory analysis demonstrated the potential for transport from the Lake Fire to Yuma on June 18 and 19, 2015, and then from Yuma to the nonattainment area on June 19 and 20, 2015.

The second addendum further included analyses to demonstrate a mechanism for mixing of the aloft smoke to ground level both between Yuma and the nonattainment area, and within the nonattainment area. The first analysis looked at dew point and water vapor data and modeling.[33] The analysis included a plot of hourly dew point measurements at the Phoenix Sky Harbor International Airport within the nonattainment area, showing that dew points were below the 5th percentile at the airport in the afternoon and evening on June 19, 2015, and remained below the 50th percentile throughout June 20, 2015. A similar drop in dew point was observed in Yuma on June 19, 2015. The second addendum suggested that this indicated that extremely dry air was mixed into the nonattainment area on June 19 and 20, 2015, from aloft. To provide further evidence for this effect, the analysis also used the Weather Research and Forecasting (WRF) model to assess how the water vapor mixing ratio varied vertically with time along a transect from the fire to the nonattainment area on June 19, 2015. This analysis showed that a "tongue" of dry air aloft began descending immediately to the west of the nonattainment area around midday on June 19, 2015, at approximately the time the initial drop in dew point was observed at the airport. This "tongue" of dry air continued to become more pronounced throughout the afternoon

[31] See second addendum, p. 10-11.
[32] See second addendum, p. 10, 12.
[33] See second addendum, p. 13-31, Appendix B.

on June 19, 2015, and eventually moved towards and into the nonattainment area later on June 19, 2015. This provided a mechanism to show that aloft air on June 19, 2015, between the Lake Fire and the nonattainment area was mixed down to ground level before reaching the nonattainment area in the evening on June 19, 2015.

Overall, the trajectory analyses provided in the second addendum, along with the satellite imagery and data, water vapor and dew point analysis, and meteorological data regarding boundary layer depths in the nonattainment area on June 20, 2015, show that emissions from the Lake Fire in California were transported to the nonattainment area and the affected monitoring sites and reached ground level on June 20, 2015.

Evidence that the wildfire emissions affected the monitor

The demonstration provided maps of daily maximum 8-hour average O_3 concentrations from June 17 through June 21, 2015, showing a regional rise in O_3 concentrations across much of Arizona on June 19 and 20, 2015, suggesting that factors affecting elevated O_3 concentrations within the nonattainment area were regional in nature. The demonstration also provided O_3 diurnal profiles of the exceeding monitors on June 20, 2015, in the narrative conceptual model, but the profiles did not include any statistical information to demonstrate how these hourly concentrations compared to typical concentrations at the sites.[34] The first addendum supplemented this analysis by providing an expanded analysis of O_3 diurnal hourly concentrations at the exceeding monitors for June 19 through 21, 2015, along with 5th, 50th, and 95th historical percentile hourly concentrations for each site, based on concentrations measured in 2010 through 2015 during the month of June. Instead of calculating percentile values for each individual day of the week, the first addendum calculated percentiles for weekdays and weekends, increasing the sample size and providing a more robust calculation of the percentiles. The addendum also presented the same information compared to percentiles calculated using data from May through August of the same years to further increase sample size for the comparison.[35] Both versions of the analysis provided in the addendum showed that for all the exceeding monitors, O_3 concentrations were at or above the 95th percentile values for several hours on June 20, 2015.

The demonstration also provided an analysis of diurnal nitrogen dioxide (NO_2) concentrations. The demonstration included plots of hourly and 24-hour NO_2 concentrations from the West Phoenix monitor averaged by day of the week, using data from the month of June in 2010 through 2014. The West Phoenix monitor was selected because it is an area-wide site within the nonattainment area, and none of the sites where O_3 exceedances were measured had available NO_2 measurements. The demonstration further plotted hourly NO_2 data from June 13 through 27, 2015, against the average hourly NO_2 concentrations described above.[36] The plots showed that NO_2 was higher in the evening hours on June 19, 2015, and early morning hours on June 20, 2015, as compared to the average hourly concentrations, and hours on the days preceding and following this period were closer to the average hourly concentrations. This analysis might suggest an unusual source of NO_2 affecting the nonattainment area on June 19 and 20, 2015. However, the analysis did not provide sufficient statistical information to assess whether the

[34] See demonstration, p. 20, 45-56.
[35] See first addendum, p. 3-9.
[36] See demonstration, p. 57-58, 62-63.

elevated NO_2 was within the range of normal concentrations measured in the nonattainment area. The first addendum supplemented the NO_2 analyses by provided an expanded statistical analysis of NO_2 similar to the expanded O_3 analysis, using data from three area-wide sites (West Phoenix, Phoenix Supersite, and Central Phoenix) within the nonattainment area.[37] The elevated NO_2 concentrations noted in the demonstration on June 19 and 20, 2015, were observed across all of the area-wide sites. At the West Phoenix monitor, NO_2 concentrations exceeded the 95th percentile value for several hours overnight prior to the exceedance day. Elevated concentrations were less pronounced at the other two sites but still approached the 95th percentile value for several hours overnight prior to the exceedance day. Both the demonstration and the first addendum noted that these high NO_2 concentrations were particularly unusual for a Saturday, as anthropogenically emitted NO_2 is typically lower on weekends. Overall, the analysis further supported the conclusion that a highly unusual NO_2 source affected the nonattainment area on June 19 and 20, 2015. However, it should be noted that NO_2 is a poor tracer for fire because it is not specific to fire emissions and is emitted in large amounts by several anthropogenic sources (e.g., cars, power plants).

The demonstration also evaluated $PM_{2.5}$, which is much more commonly associated with fire emissions than NO_2, but found that $PM_{2.5}$ was not elevated within the nonattainment area prior to or during the exceedance day. The demonstration plotted hourly $PM_{2.5}$ concentrations for the Yuma Supersite and Alamo Lake monitors for June 17 through 21, 2015, and stated that $PM_{2.5}$ was elevated at these monitors during this period due to the Lake Fire.[38] However, the plots did not provide any statistical information to compare the concentrations to typical concentrations at these monitors, and it was unclear whether the peaks noted on the plot were associated with transport from the wildfire. For example, the highest concentrations observed during this period at the Yuma Supersite monitor were observed in the evening on June 17 through early morning on June 18, 2015, prior to when the earliest emissions from the Lake Fire could have been transported to Yuma.

To address the lack of elevated $PM_{2.5}$ observed in the nonattainment area, the demonstration and first addendum examined speciation data from the Chemical Speciation Network (CSN) available at the Phoenix Supersite monitoring site for elemental carbon (EC) and organic carbon (OC). The demonstration presented the sum of EC and OC concentrations and the percentage of the total $PM_{2.5}$ concentration present as EC and OC for every CSN sample day between June 11, 2015 and June 29, 2015.[39] This analysis showed that the total EC and OC and percentage of total $PM_{2.5}$ present as EC and OC was highest on June 20, 2015, as compared to the six other sample days in the analysis. However, the analysis did not provide any statistical information to demonstrate how these values compared to typical values at the site. The analysis also looked at the sum of EC and OC rather than the individual components or ratio; biomass smoke is generally associated with a high OC component and relatively low EC/OC fraction, rather than a high total concentration of both EC and OC. The first addendum supplemented the original analysis by including a comparison of total OC, OC/$PM_{2.5}$, EC, EC/$PM_{2.5}$, and EC/OC on the exceedance day in comparison to all samples from 2010 through 2015 collected during the

[37] See first addendum, p. 17-20.
[38] See demonstration, p. 57, 59-60.
[39] See demonstration, p. 57, 61.

month of June, as well as those collected in the months of May through August.[40] The analysis also provided percentile values for comparison. For both versions of the analysis, the exceedance day OC concentration was above the 95th percentile value, and the OC/$PM_{2.5}$ ratio was near the 95th percentile, suggesting a higher than usual contribution of OC. The exceedance day EC concentration was between the 50th and 95th percentile and the ratio of EC/$PM_{2.5}$ was near the 50th percentile, suggesting an approximately typical contribution of EC. The percentile of EC/OC was between the 5th and 50th percentile, further supporting that OC was elevated relative to EC. The EC and OC analysis provides some support that wildfire emissions were present in the nonattainment area.

Overall, the lack of elevated $PM_{2.5}$ in the nonattainment area raises questions about the extent to which wildfire emissions reached the ground and affected the monitor. However, the supplemental analyses showing elevated OC and relatively low EC/OC concentrations, and unusually elevated NO_2 and O_3 concentrations observed on a Saturday, along with the robust analysis of transport and mixing mechanisms described earlier in this document, ultimately support the conclusion that wildfire emissions reached the ground and affected measurements at the exceeding monitors on June 20, 2015.

Additional evidence that the wildfire emissions caused the O_3 exceedance

The demonstration and addenda provided additional evidence to support that the wildfire emissions caused the O_3 exceedances observed on June 20, 2015. The demonstration included a multivariable regression analysis using several meteorological parameters in an effort to show that O_3 concentrations at the monitoring sites were elevated above expected concentrations.[41] While the regression-predicted O_3 concentrations at the exceeding monitors were all lower than the observed O_3 concentrations, possibly suggesting an unexpected source contribution to the observed concentrations, these differences did not meet the metrics described in the EPA's wildfire O_3 guidance for statistical models, and the regression model appeared to consistently underpredict O_3 at high concentrations, including for non-event exceedances.

The first addendum added a matching day analysis, which included three evaluations: first, an examination of days in 2010 through 2015 during the month of June with similar meteorological conditions to June 20, 2015;[42] second, an examination of the conditions of all exceedance days in 2010 through 2015 during the month of June in comparison to June 20, 2015;[43] and third, a discussion of the characteristics of June 20, 2015, as a rare Saturday exceedance.[44]

The analysis for days with similar meteorological conditions identified ten matching days based on resultant wind directions, resultant wind speed, average wind speed, average temperature, maximum and minimum temperatures, and the exclusion of days with significant weather events (e.g., large dust storms, heavy rain). Of the ten matching days selected, eight of the days did not record exceedances of the 2008 O_3 NAAQS at any of the monitors that exceeded on June 20, 2015, and several of those days measured concentrations across the network that were well below the NAAQS. One of the remaining days (June 1, 2012) measured an exceedance at only

[40] See first addendum, p. 10-16.
[41] See demonstration, p. 65-68, Appendix D.
[42] See first addendum, p. 21-23.
[43] See first addendum, p. 24-25.
[44] See first addendum, p. 26-28.

one of the six monitors that exceeded on June 20, 2015 (Tonto National Monument); the other day (June 9, 2014) measured exceedances at four of the six monitors. These two exceedance days occurred on weekdays, which generally have higher O_3 precursor emissions, and followed exceedances that occurred on the prior day. In contrast, the June 20, 2015 exceedance was measured on a Saturday and did not follow a prior exceedance. Overall, the first addendum concluded that the first matching day analysis showed that the O_3 concentrations on June 20, 2015, were unusual compared to days with similar meteorology, which generally did not result in exceedances of the 8-hour 2008 O_3 NAAQS on days with the same emission characteristics as the June 20, 2015 exceedance.

The analysis of monitored non-event exceedance days identified 22 other exceedance days, besides the event day, that occurred in 2010 through 2015 during the month of June where exceedances of the 2008 O_3 NAAQS occurred at one or more of the six monitors that exceeded on June 20, 2015. Many of these exceedance days measured exceedances at only one or two of the six monitors that exceeded on June 20, 2015. The analysis further analyzed three of the exceedances. The first exceedance was June 9, 2014, which was identified as the most similar exceedance to June 20, 2015. This day was identified by the first matching day analysis as having similar meteorology to June 20, 2015, experienced exceedances at four of the same six monitors, and the magnitude of the exceedances were comparable. As previously discussed, however, June 9, 2014, differed from June 20, 2015, in that it was part of a multi-day event (June 5, 2014, through June 9, 2014) during which stagnant air conditions allowed O_3 to build up in the nonattainment area, and it occurred on a weekday. The analysis also further analyzed June 1, 2013, and June 7, 2014, which were both Saturday exceedances, similar to the event day. These were the only other Saturday exceedances during the month of June over the six year period. However, both of these exceedance days were characterized by higher exceedances on the day prior (Friday), unlike the event day, indicating that the June 20, 2015 exceedance was unique.

The third analysis examined O_3 exceedance days for the six monitors that exceeded on June 20, 2015, by exceeding monitor and day of week from the O_3 season (April through October) over a six-year period (2010 through 2015), excluding the event day. The analysis indicated that Saturdays accounted for only 7% of the exceedances measured for the entire six-year period and 9% of exceedances during the month of June. Saturdays had the second least percentage of exceedances (the least was Sunday). For three of the monitors that exceeded on June 20, 2015 (Apache Junction, Blue Point, and Tonto National Monument), no other Saturday exceedances were measured during the six-year period. Falcon Field experienced one Saturday exceedance (out of eleven total), Mesa experienced two (out of 15 total), and Pinnacle Peak experienced three (out of 28 total). This analysis shows that Saturday exceedances are rare, particularly for some of the monitors that exceeded on June 20, 2015, and points to a unique emissions source contributing to exceedances.

The analyses included in the demonstration and addenda, specifically, the comparison with historical hourly and daily maximum 8-hour O_3 concentrations; updated HYSPLIT analyses, satellite imagery and data, water vapor and dew point analysis, and meteorological data regarding boundary layer depths in the nonattainment area on June 20, 2015; elevated OC and relatively low EC/OC concentrations, and unusually elevated NO_2 and O_3 concentrations observed on a Saturday; and three matching day analyses demonstrating the unusual nature of the

event, sufficiently demonstrate a clear causal relationship between the emissions generated by the Lake Fire in the San Bernardino National Forest in southeastern California and the exceedances measured at the Apache Junction, Blue Point, Falcon Field, Mesa, Pinnacle Peak, and Tonto National Monument monitoring sites.

Table 3: Documentation of Clear Causal Relationship

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 20, 2015	Demonstration – p. 21-68 First addendum – p. 3-28 Second addendum – p. 6-36, Appendix B	Sufficient	Yes

Not Reasonably Controllable or Preventable

The EER presumes that wildfire events on wildland are not generally reasonable to control or prevent. The demonstration provided evidence that the wildfire event meets definition of a wildfire. Specifically, the demonstration includes evidence that the Lake Fire was a wildfire on wildland, and further, occurred outside of Arizona. Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of Not Reasonably Controllable or Preventable

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 20, 2015	Demonstration – p. 8-13, 69	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR 50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." The demonstration includes documentation that the event meets the definition of a wildfire and occurred predominantly on wildland, and has therefore shown that the event was a natural event.

Table 5: Documentation of Natural Event

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 20, 2015	Demonstration – p. 8-13, 69	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR 50.14(c) and 40 CFR 51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR 50.14 (c)(1)(i)	Demonstration: p. 3, Appendix A	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR 50.14 (c)(2)(i)	Demonstration: p. 3-4, Appendix F	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR 50.14 Table 2 40 CFR 50.14 (c)(2)(i)(B)	NA	NA
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR 50.14 (c)(3)(v)	Demonstration: p. 4, Appendix E First addendum: p. 2, Appendix B; July 17, 2018 Letter[45] Second addendum: p. 1, Appendix C; April 26, 2019 Letter[46]	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR 51.930 (b)	NA	NA

Conclusion

The EPA has reviewed the documentation provided by ADEQ to support claims that smoke from wildfires in the San Bernardino National Forest caused exceedances of the 2008 8-hour O_3 NAAQS at the Apache Junction, Blue Point, Falcon Field, Mesa, Pinnacle Peak, and Tonto National Monument monitoring sites on June 20, 2015. The EPA has determined that the flagged exceedances at these monitoring sites on this day satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedances, and was not reasonably controllable or preventable. The EPA has also determined that ADEQ has satisfied the procedural requirements for data exclusion.

[45] See letter from Timothy Franquist, ADEQ, to Michael Stoker, EPA Region 9, dated July 17, 2018.
[46] See letter from Timothy Franquist, ADEQ, to Michael Stoker, EPA Region 9, dated April 26, 2019.